Calibration of a weight of nominal value 10 kg	

## Calibration of a weight of nominal value 10 kg

The calibration of a weight of nominal value 10 kg of OIML class M1 is carried out by comparision to a reference standard (OIML class F2) of same nominal value using a mass comparator whose performance characteristics have previously been determined.

## Model Equation:

 $m_{X}=m_{S}+\delta m_{D}+\delta_{m}+\delta m_{C}+\delta_{B}$ 

## List of Quantities:

Quantity	Unit	Definition	
m <sub>X</sub>	g	conventional mass of the unknown	
m <sub>s</sub>	g	conventional mass of the standard	
$\delta m_D$	g	change of value of the standard since its last calibration due to drift	
δ <sub>m</sub>	g	g observed difference in mass between the unknown mass and the standard	
$\delta m_{C}$	g	correction for eccentricity and magnetic effects	
δ <sub>B</sub>	g	correction for air buoyancy	

m<sub>s</sub>:

Type B normal distribution Value: 10000.005 g Expanded Uncertainty: 45-10<sup>-3</sup> g Coverage Factor: 2

REFERENCE STANDARD: The calibration certificate for the reference standard gives a value of 10 000,005 g with an associated expanded uncertainty of 45 mg (coverage factor k=2)

**δm**<sub>D</sub>:

Type B rectangular distribution Value: 0 g Halfwidth of Limits: 15.10<sup>-3</sup> g

DRIFT OF THE VALUE OF THE STANDARD: The drift of conventional mass of the reference standard is estimated from previous calibrations to be zero within limits ±15 mg

Date: 07/07/2005	File: S02.smu	Page 1 of 3

δ <sub>m</sub> :	Type A Method o Number o	f observation: Indire	ect SUUS			
	No.	Hint	Reading	C	Observation	
	1	Standard	0.010 g			
		Unknown	0.020 g			
		Unknown	0.025 g			
		Standard	0.015 g		0.0100 g	
	2	Standard	0.025 g			
		Unknown	0.050 g			
		Unknown	0.055 g			
		Standard	0.020 g		0.0300 g	
	3	Standard	0.025 g			
		Unknown	0.045 g			
		Unknown	0.040 g			
		Standard	0.020 g		0.0200 g	
COMPARA between tw δ <b>m<sub>C</sub>:</b>	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA o weights of sam Type B re Value: 0 o	c Mean: 0.02000 g tandard Deviation: egrees of Freedom Uncertainty: 0.014 TION: A previous e e nominal value giv ectangular distributi	25⋅10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled es on	e repeatability o timate of standa	f the mass c ird deviation	difference n of 25 mg.
COMPARA between tw δm <sub>C</sub> : COMPARA and magne δ <sub>B</sub> : AIR BUOY/ estimated t	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0.10 <sup>-6</sup> of t	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014 TION: A previous e e nominal value giv ectangular distributi of Limits: 10.10 <sup>-3</sup> g on are applied for th hated to have rectain ectangular distributi g of Limits: 10.10 <sup>-3</sup> g ion is made for the the nominal value	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled est on he comparator to ngular limits of to on l effects of air bo	e repeatability o timate of standa whereas the und ±10 mg	f the mass our of the mass of deviation	difference n of 25 mg. e to eccentrici on are
COMPARA between tw $\delta m_{\rm C}$ : COMPARA and magne $\delta_{\rm B}$ : AIR BUOY/ estimated t <b>Uncertain</b> $m_{\rm X}$ :	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 of Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 of Halfwidth ANCY: No correct o be ±1.0-10 <sup>-6</sup> of t	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014 TION: A previous e e nominal value giv ectangular distributi of Limits: 10.10 <sup>-3</sup> g on are applied for th hated to have rectain ectangular distributi of Limits: 10.10 <sup>-3</sup> g ion is made for the he nominal value	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled est on he comparator to ngular limits of to on effects of air bo unknown	e repeatability o timate of standa whereas the und ±10 mg	f the mass our of the mass of deviation	difference n of 25 mg. e to eccentrici
COMPARA between tw $\delta m_{\rm C}$ : COMPARA and magne $\delta_{\rm B}$ : AIR BUOY/ estimated to <b>Uncertain</b> $m_{\rm X}$ : Quantity	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0.10 <sup>-6</sup> of t	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014 TION: A previous e e nominal value giv ectangular distributi of Limits: 10.10 <sup>-3</sup> g on are applied for the hated to have rectain ectangular distributi g of Limits: 10.10 <sup>-3</sup> g ion is made for the he nominal value onal mass of the to Standard Uncertainty	25.10 <sup>-3</sup> g 20 g evaluation of the res a pooled est on he comparator ngular limits of on effects of air be unknown Distribution	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit Sensitivity Coefficient	f the mass our of deviation deviation certainty due to the second	difference n of 25 mg. e to eccentrici on are inty Index tion
COMPARA between tw $\delta m_{\rm C}$ : COMPARA and magne $\delta_{\rm B}$ : AIR BUOY/ estimated t <b>Uncertain</b> $m_{\rm X}$ : <b>Quantity</b> $m_{\rm S}$	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0·10 <sup>-6</sup> of the ty Budgets: conventi Value	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014. TION: A previous e e nominal value giv ectangular distributi of Limits: 10.10 <sup>-3</sup> g on are applied for the hated to have rectain ectangular distributi of Limits: 10.10 <sup>-3</sup> g ion is made for the he nominal value onal mass of the u Standard Uncertainty 0.02250 g	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled est on he comparator to ngular limits of the on effects of air be unknown Distribution normal	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit <u>Sensitivity Coefficient</u> 1.0	f the mass our deviation of the mass of deviation of the mass of the second sec	difference n of 25 mg. e to eccentrici on are inty Index tion 59.6 %
COMPARA between tw $\delta m_{C}$ : COMPARA and magne $\delta_{B}$ : AIR BUOY estimated t <b>Uncertain</b> $m_{X}$ : Quantity $m_{S}$ $\delta m_{D}$	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0·10 <sup>-6</sup> of t ty Budgets: conventi Value 10000.00500 g 0.0 g	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014. TION: A previous e e nominal value giv ectangular distributi of Limits: 10-10 <sup>-3</sup> g on are applied for the nated to have rectai ectangular distributi g of Limits: 10-10 <sup>-3</sup> g ion is made for the the nominal value onal mass of the u Standard Uncertainty 0.02250 g 8.660-10 <sup>-3</sup> g	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled est on he comparator ngular limits of the on effects of air be unknown Distribution normal rectangular	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit <b>Sensitivity</b> <b>Coefficient</b> 1.0 1.0	f the mass of deviation de	difference n of 25 mg. e to eccentrici on are inty Index tion 59.6 % <sup>3</sup> g 8.8 %
COMPARA between tw $\delta m_{C}$ : COMPARA and magne $\delta_{B}$ : AIR BUOY/ estimated to Uncertain $m_{X}$ : Quantity $m_{S}$ $\delta m_{D}$ $\delta_{m}$	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0.10 <sup>-6</sup> of t ty Budgets: conventi Value 10000.00500 g 0.0 g 0.0 g	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014 TION: A previous e e nominal value giv ectangular distribution of Limits: 10.10 <sup>-3</sup> g on are applied for the nated to have rectain ectangular distribution of Limits: 10.10 <sup>-3</sup> g ion is made for the he nominal value <b>onal mass of the u</b> <b>0.02250</b> g 8.660.10 <sup>-3</sup> g 0.01420 g	25.10 <sup>-3</sup> g :: 50 20 g evaluation of the res a pooled est on he comparator ngular limits of on effects of air be unknown Distribution normal rectangular normal	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit <u>Sensitivity</u> <u>Coefficient</u> 1.0 1.0 1.0	f the mass of deviation certainty due ts of deviation Uncertain Contribu 0.022 8.7.10 <sup>-3</sup>	difference n of 25 mg. e to eccentrici on are inty tion g 59.6 % <sup>3</sup> g 8.8 % g 23.7 %
COMPARA between tw $\delta m_{C}$ : COMPARA and magne $\delta_{B}$ : AIR BUOY/ estimated t Uncertain $m_{X}$ : Quantity $m_{S}$ $\delta m_{D}$ $\delta_{m}$ $\delta m_{C}$	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0.10 <sup>-6</sup> of to ty Budgets: conventi Value 10000.00500 g 0.0 g 0.0 g	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014. TION: A previous e e nominal value giv ectangular distributi of Limits: 10.10 <sup>-3</sup> g on are applied for the hated to have rectain ectangular distributi of Limits: 10.10 <sup>-3</sup> g ion is made for the he nominal value <b>onal mass of the u</b> <b>Standard</b> <b>Uncertainty</b> 0.02250 g 8.660.10 <sup>-3</sup> g 0.01420 g	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled esi on he comparator i ngular limits of i on effects of air bo unknown Distribution normal rectangular rectangular	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit <u>Sensitivity Coefficient</u> 1.0 1.0 1.0 1.0	f the mass of and deviation certainty due ts of deviation Uncertain Contribu 0.022 8.7·10 <sup>-3</sup> 0.014 5.8·10 <sup>-3</sup>	difference a of 25 mg. e to eccentrici on are inty Index inty 59.6 % g 59.6 % g 23.7 % 3 g 3.9 %
COMPARA between tw $\delta m_{C}$ : COMPARA and magne $\delta_{B}$ : AIR BUOY/ estimated t Uncertain $m_{X}$ : Quantity $m_{S}$ $\delta m_{D}$ $\delta_{m}$ $\delta m_{C}$ $\delta_{B}$	Arithmetic Pooled S Pooled D Standard TOR / OBSERVA to weights of sam Type B re Value: 0 g Halfwidth TOR: No correcti tic effects is estim Type B re Value: 0 g Halfwidth ANCY: No correct o be ±1.0·10 <sup>-6</sup> of t ty Budgets: conventi Value 10000.00500 g 0.0 g 0.0 g 0.0 g 0.0 g	c Mean: 0.02000 g tandard Deviation: 1 egrees of Freedom Uncertainty: 0.014. TION: A previous e e nominal value giv ectangular distribution of Limits: 10-10 <sup>-3</sup> g on are applied for the nated to have rectain ectangular distribution of Limits: 10-10 <sup>-3</sup> g ion is made for the the nominal value onal mass of the u Standard Uncertainty 0.02250 g 8.660-10 <sup>-3</sup> g 0.01420 g 5.774-10 <sup>-3</sup> g	25.10 <sup>-3</sup> g : 50 20 g evaluation of the res a pooled est on he comparator ngular limits of on effects of air be unknown Distribution normal rectangular rectangular rectangular	e repeatability o timate of standa whereas the und ±10 mg byancy, the limit Coefficient 1.0 1.0 1.0 1.0 1.0 1.0	f the mass of and deviation certainty due ts of deviation <b>Uncertai</b> <b>Contribu</b> 0.022 8.7·10 <sup>-3</sup> 0.014 5.8·10 <sup>-3</sup>	difference a of 25 mg. e to eccentrici on are inty Index inty 59.6 % g 59.6 % g 23.7 % <sup>3</sup> g 3.9 %

		Calibration of a weight of nominal value 10 kg	
--	--	--	--

## **Results:**

Quantity	Value	Expanded Uncertainty	Coverage factor	Coverage
m <sub>x</sub>	10000.025 g	0.058 g	2.00	95% (t-table 95.45%)